Modern techniques in genetic modification, or *biotechnology*, have unimaginable utility to an immense range of industries. GM technology has the potential to help alleviate problems like fossil fuel dependency, pollution, malnutrition, and clinical illness.

To begin, let’s discuss how we should *not* approach arguments for or against biotechnology:

- Public opinion. Only a small minority of the public has education in related fields.
- Private sponsorship. For example, companies or websites promoting “eco”/“natural”.
- Celebrity sponsorship. Anti-GM activists gain publicity by presenting biased data

When is it appropriate to include a mandatory label on a commercial product? Current examples include nutritional information tables, hazard indicators, and medically relevant contents (gluten, phenylalanine, allergens, *etc*). All of these are related to proven public health concerns.

When is it appropriate to include an optional label on a commercial product? Companies will choose to include labels for marketing reasons. “*Fresh*”, “*natural*”, “*GMO-free*”. These sorts of labels are not necessarily based in fact and often dance the line of fraudulent advertising. In fact, many products labelled GMO-free have been demonstrated to contain traces of GM molecules. It is particularly difficult to trace the origins of every ingredient in a processed food, and a baffling number of packaged products in grocery stores have traces of GM corn or soy. Labelling all products which contain GM products would require the establishment of a panel which investigates food origins, adding expense to the already financially taxing act of printing and placing physical labels.

The argument for or against mandatory GMO labelling should be addressed by relying on a very simple principle: scientific evidence. GMOs do not endanger the health of the public, and GMOs do not cause more environmental damage than their natural relatives. Labelling GMOs sends an unacceptable message, as it implies a non-existent difference between GM and “natural” foods.

There are plenty of examples of mandatory labelling schemes not currently in place, which have ample evidence to support them. Foods could be labelled based on what pesticides are used on them, or by how many fossil fuels were consumed in their production and transport, or if the farmers who grew it were paid an unfair wage. Each of these examples has demonstrable negative impacts, and yet consumers do not have the legal right to know about them.

Because mandatory labelling inarguably creates undue financial strain, any attempt to legislate such a regulation needs to be backed up with evidence of its benefit. To demand labelling specifically for GM crops, one must provide sufficient evidence of their harm.

Effects of GM foods on human health

American Medical Association:

"There is no scientific justification for special labeling of genetically modified foods. Bioengineered foods have been consumed for close to 20 years, and during that time, no overt consequences on human health have been reported and/or substantiated in the peer-reviewed literature."

World Health Organization:

"No effects on human health have been shown as a result of the consumption of GM foods by the general population in the countries where they have been approved."

Royal Society of Medicine:

"Foods derived from GM crops have been consumed by hundreds of millions of people across the world for more than 15 years, with no reported ill effects (or legal cases related to human health), despite many of the consumers coming from that most litigious of countries, the USA."

American Association for the Advancement of Science:

"The science is quite clear: crop improvement by the modern molecular techniques of biotechnology is safe."

American Society for Microbiology:

"The ASM is not aware of any acceptable evidence that food produced with biotechnology and subject to FDA oversight constitutes high risk or is unsafe. We are sufficiently convinced to assure the public that plant varieties and products created with biotechnology have the potential of improved nutrition, better taste and longer shelf-life."

American Council on Science and Health:

"With the continuing accumulation of evidence of safety and efficiency, and the complete absence of any evidence of harm to the public or the environment, more and more consumers are becoming as comfortable with agricultural biotechnology as they are with medical biotechnology."

European Commission:

"The main conclusion to be drawn from the efforts of more than 130 research projects, covering a period of more than 25 years of research, and involving more than 500 independent research groups, is that biotechnology, and in particular GMOs, are no more risky than e.g. conventional plant breeding technologies."

Effects of GM foods on the environment, and other issues

Two very important problems exist in the world of agricultural today.

- Monocropping: growing fields of genetically identical seeds
- Pollution: overuse of fertilizers and biocides (pesticides and herbicides)

Monocropping has various negative effects. The Irish Potato Famine was caused by growing a single species of potato. Reducing biodiversity creates an assortment of problems for the crop and its environment – any farmer will tell you to cycle your fields. Monocropping increases susceptibility to diseases and environmental changes. Monocropping is not a sustainable agricultural practice – but it has very little if anything to do with biotechnology. **GM crops can be (and have been) grown in polyculture**. Monocropping has been a problem since before the dawn of molecular biotechnology, so it is not an argument in support of GM labelling.

Fertilizer and pesticide/herbicide use can be dangerous to the environment. Overuse of fertilizer can lead to nutrient runoff; high levels of Nitrogen can be washed away from farms and into water sources. In these water sources, high Nitrogen levels can promote the development of algal blooms which can in term deplete dissolved oxygen, leading to impacts on higher trophic levels. News articles show up every once in a while about a beach full of dead fish because of an algal bloom resulting from fertilizer overuse. But again, this has nothing to do with GM foods. **Fertilizer use should be regulated, absolutely, on natural foods and GM foods alike**.

The overuse of pesticides and herbicides can also have unintended biological impacts. However, and this is a common theme, *these issues do not stem from biotechnology*. Labelling GM foods because they encourage the use of pesticides is nonsensical, why not regulate the pesticide itself? In fact, **many GM foods are designed to reduce the use of biocides**. For example, Bt cotton produces its own insecticide so there is no need to spray fields from the air.

Anti-GM activists often point to practices by Monsanto as a reason to limit the production of GMOs. This argument is a complete non sequitur and is infuriating to pro-GM activists. The actions of Monsanto are entirely separate from the value of GM crops. Plenty of other companies are in the biotechnology business, and many GM crop patents are now available for public use. Furthermore, anti-GM articles are often biased and paint an incorrect picture of GM litigations. Monsanto has never sued a farmer for *accidentally* growing a wayward seed. Seed-saving contracts have been in place long before the dawn of biotechnology. A recurring claim is the "death of the small farmer" – but small family farms still dominate North American markets.

Comparison to “naturally” bred crops

Since the early 1900s, plant breeders have developed new strains of crop by dosing seeds with massive amounts of radiation or mutagenic chemicals. These processes are designed to indiscriminately mutate the genome, resulting in unknown effects on cellular function. If you looked at a diagram of crop genomes which compared wild strains against human-grown strains you would see mutations everywhere - the diagram would be an absolute mess. Most of those mutations do nothing, but some (or just one) of them results in the fantastic changes in growth which breeders are hoping for. A field of a million mutagenized plants might produce only dozens of viable crops, with few or none exhibiting a positive change in plant morphology. Obviously these plants are genetically crippled; to alleviate this, breeders will back-cross non-mutant crops with the mutated strain for a few generations. Eventually, a crop is found that grows with the desired characteristics. If you were to grow an ancient wild-type crop under the same conditions as a modern mutated crop, it wouldn't be a contest - we really have honed these crops to the same level of perfection that dog breeders have honed Shih Tzus. Undesired mutations are still there, hiding in the genome... they are just very subtle mutations, otherwise they would have been bred out. For example, a strain of potato was naturally bred in recent years which produced a toxin rendering it poisonous. In any case, cross-breeding crops even without the use of mutagenic methods has the potential to stochastically generate a toxic product.

“Naturally” bred food crops were not produced by nature. They were produced by human intervention to generate lots of random mutations of unknown consequence. Genetically modified crops, on the other hand, are designed very carefully and tested very thoroughly. GM crops contain a select few mutations, all of which are well characterized and in most cases only utilize DNA sequences found within the same family of crop. I cannot stress enough the amount of testing a GM crop will go through before it ends up on shelves, compared to little or no testing for new strains of crops produced using a less elegant method.

Labelling GM crops is the first step towards tainting public opinion of biotechnology. There are already countries which have outlawed GM foods, predominately because of public or corporate pressure. This issue needs to be approached scientifically, without bias. Genetic modification is the most powerful agricultural tool ever developed, and it has untold potential for our future.